Space Weather Technical Forecast

Issued on Tuesday 19 November 2024 at 01:04 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: High Speed Stream solar winds bring a likelihood of enhanced geomagnetic activity at times.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate during the past 24 hours, with a peak flare of M3.7 at 18/1253 UTC, originating from AR3901 near the southeast limb.

There are currently eight sunspot regions on the visible disc. Newly numbered AR3901 in the southeast is showing some magnetic complexity, although it remains difficult to analyse due to foreshortening effect. There is a lot of magnetic looping associated with this region as seen in SDO/AIA 171 imagery. Another newly numbered region AR3900 in the northeast looks small and simple at present. The largest sunspot region remains AR3889 in the west, although this region is beginning to rotate around the western limb. The other regions are simple and magnetically uncomplicated.

At 18/1112UTC an M1.6 flare originating from AR3897 in the southwest produced a CME, which was slow-moving. This has been analysed using LASCO C2 and C3 imagery. Results show that this feature is a clear miss, passing ahead of Earth' orbit.

A large CME was observed off the east limb, associated with an M2-flare near AR3901 in the southeast. This is currently being analysed, although unlikely to have any Earth-directed component, given its location.

No Earth-directed CMEs were observed over the past 24 hours in available imagery.

Solar Wind / Geomagnetic Activity: Solar winds at L1 measured by ACE were indicative of a slow regime until 18/0940 UTC, with the arrival of HSS from CH92/+, which is currently near the western limb. Solar winds reached between 300-490km/s, peaking at 18/1441 UTC, before slowly declining, currently near 400km/s at present.

The solar wind density was below average. The interplanetary magnetic field (IMF), Bt, was weak to moderate 7-9nT. The north-south component was weakly negative, reaching -8nT at 18/0220 UTC. The phi angle was mostly positive (away from the Sun). The net result of the above solar wind measures was Quiet (0-2Kp) geomagnetic activity.

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Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 remained at Background levels.

High energy electron flux (greater than 2MeV) observed by GOES16 was at Normal Background to Moderate levels, with a diurnal peak of 529pfu observed at 18/1705 UTC. The associated 24-hour fluence remained below the Active threshold, and the 24-hour integrated flux observed at 19/0000 UTC was 1.35e7.

Four-Day Space Weather Forecast Summary

Solar Activity: Low to Moderate activity is expected, with the arriving regions contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast.

The forecast is dominated by coronal hole fast winds. Earth is currently in a HSS from CH92/+ with solar winds between slightly elevated to background, currently near 400km/s, which looks set to continue through Day 1 (19 Nov). Solar winds may wane into Day 2 (20 Nov) before the onset of another HSS from CH93/- on Days 3 and 4 (21-22 Nov), with solar winds reaching slightly elevated or elevated levels.

Quiet to Unsettled (Kp0-3) conditions expected through much of the period, with a chance of Active (Kp4) intervals through Day 1 (19 Nov), then mostly Quiet by Day 2 (20 Nov). Activity is expected to increase Days 3 and 4 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals.

Energetic Particles / Solar Radiation: There is a daily Slight Chance of S1/Minor solar radiation storms mainly due to AR3889's position as it crosses the western limb. High energy electron flux is likely to remain at background to moderate (during diurnal peaks) throughout the period. The associated fluence most likely remaining below the Active (1e8 integrated flux) threshold.

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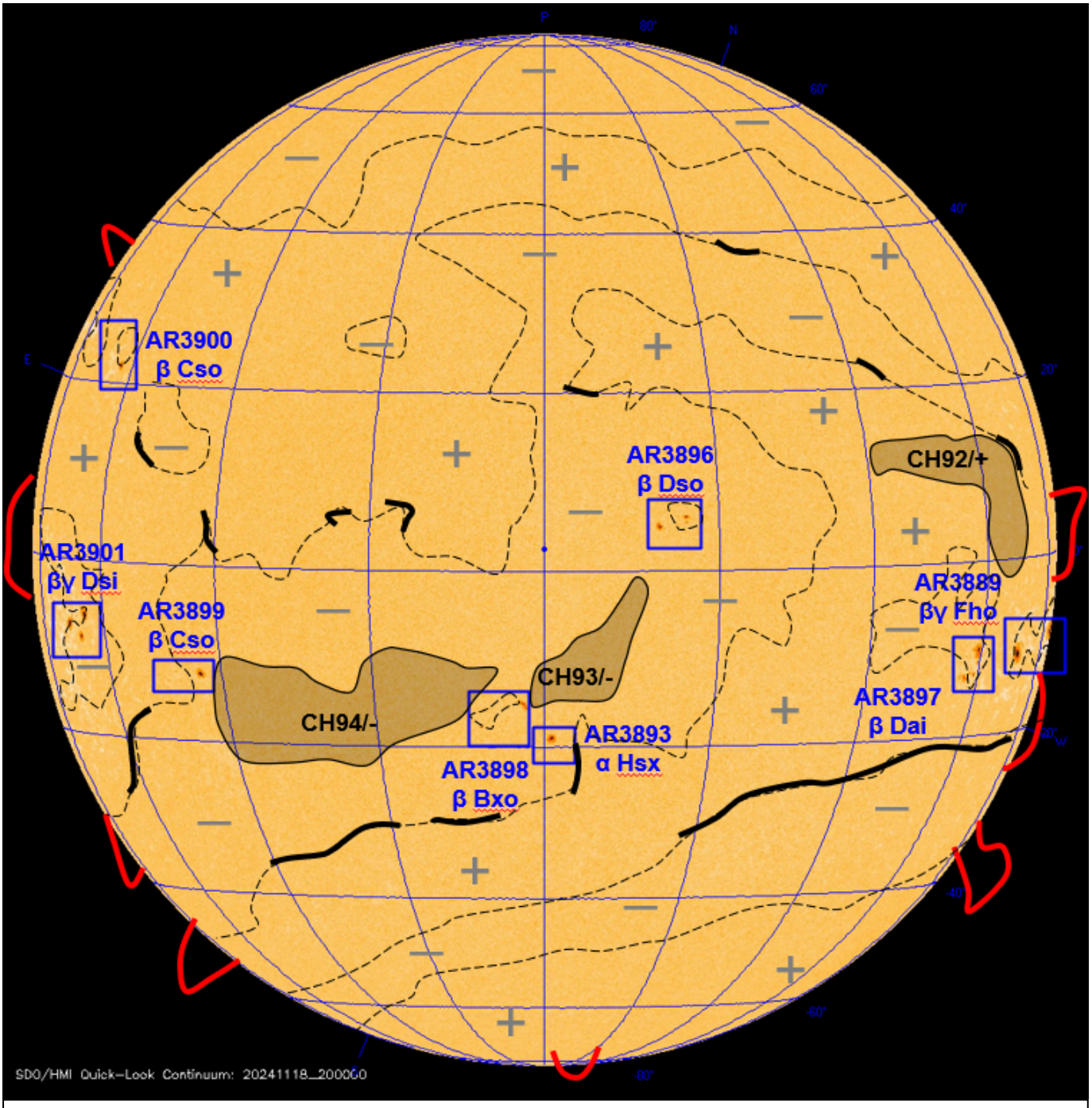
Figure 1: Solar Synoptic Map valid 18/2000 UTC



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No CMEs feature in the forecast.

The forecast is dominated by coronal hole fast winds, with two main source regions on the visible disk. An enhancement from CH92/+ was established on 18 Nov, with solar winds reaching slightly elevated levels. This enhancement is expected to continue during Day 1 (19 Nov), with solar winds probably reaching between 400-450km/s. Winds may wane into Day 2 (20 Nov) but with the threat of a further enhancement to slightly elevated or elevated levels Days 3 and 4 (21-22 Nov) with the increasing risk of enhancement from the large CH93/- now approaching centre disk. An enhancement in solar winds to 550-600km/s is currently suggested by MOSWOC ENLIL output , although this viewed with caution, probably considered too high and too early to bring in any enhancement. Also, CH93 is negative polarity and is unlikely to give any significant geomagnetic activity, based on previous rotation.

Quiet to Unsettled (Kp0-3) conditions expected through much of the period, with a chance of Active (Kp4) intervals through Day 1 (19 Nov). Activity probably increasing through Days 3 and 4 (21-22 Nov) becoming generally Unsettled to Active (Kp3-4) with a chance of G1 Minor Geomagnetic Storm intervals depending on the strength of any enhancement from CH93/- and any associated CIR region.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	1	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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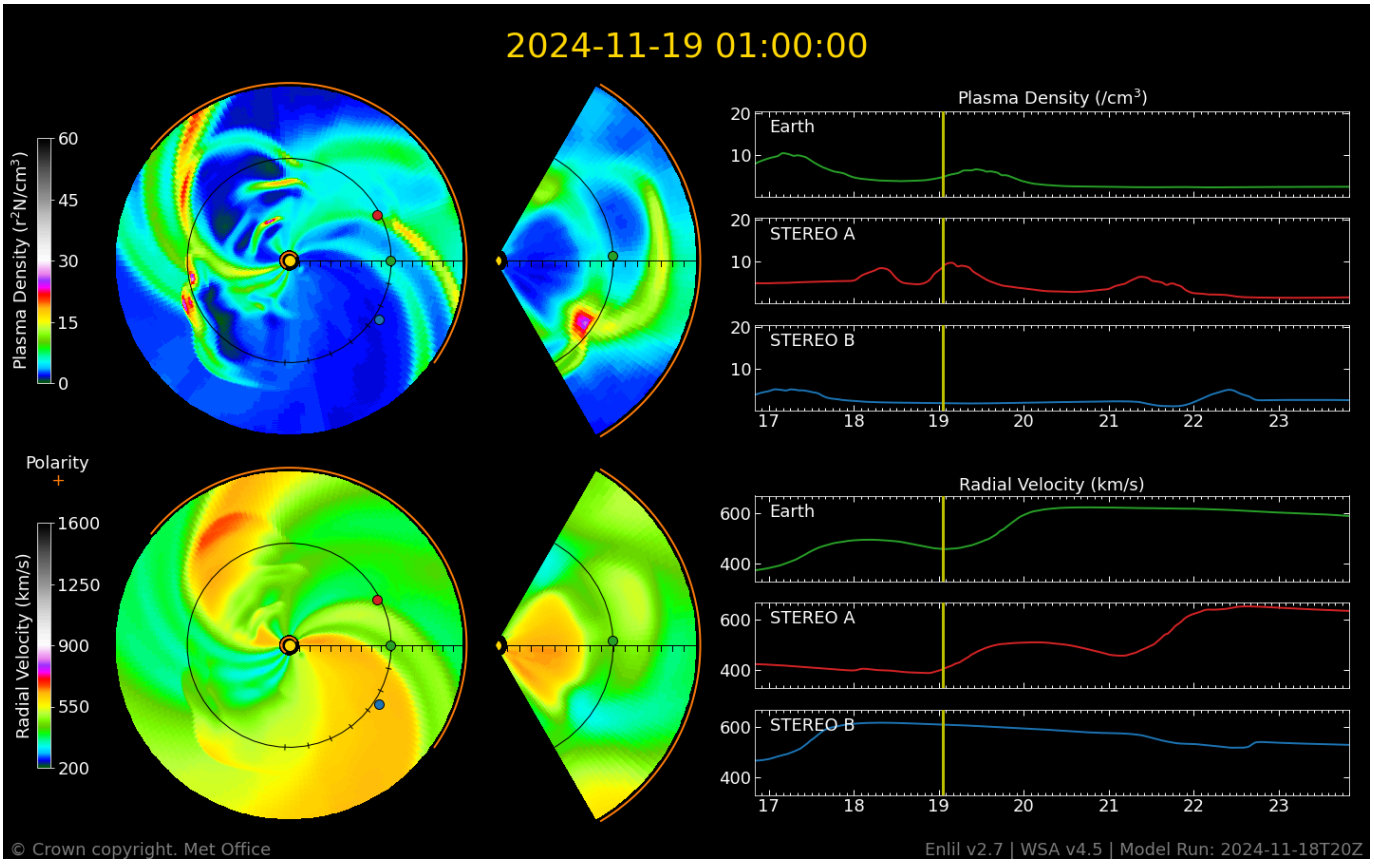
Figure 2: Latest ENLIL model output.



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Radio Blackouts - X-Ray Flares

Of the current front-sided sunspot groups, AR3889 in the southwest has historically carried the bulk of the current flare risk, but has steadily reduced given the recent simplification of the region, with oncoming regions in the southeast looking to increasingly represent the highest flare risk.

No particularly large far side regions are suggested by far-side sounding data, however recurrence suggests the position of a number of regions near the eastern limb and this minimises and reduces confidence in the signal from soundings. Recurrence, supported by brightening and magnetic looping on the eastern limb in SDO/AIA imagery and recent far-sided CMEs, continue to suggest the potential for sunspot regions to return to the visible disc over the period. Likely the first of which has emerged across the east limb, which has been numbered AR3901, although this region remains difficult to analyse due to foreshortening. This region has already produced an M3.7 flare at 18/1253 UTC.

Overall Low to Moderate activity is expected, with the arriving regions on the east limb contributing to a daily chance of M-class flares and a persistent slight chance of isolated X-class flares, with the risk maintained steady through the period pending further developments. A chance of further Moderate activity and a continued slight chance of X-flares is maintained.

X-Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 (M Class)	Yes	50	50	50	50
Very Active	R3-R5 (X Class)	No	10	10	10	10

Figure 3: GOES16-18 X-Ray flux - shows recent M-class flares.

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Solar Radiation Storms (High Energy Protons)

There is a slight chance of S1/Minor Solar Radiation storms over the period, chiefly due to any potential significant flaring from AR3889 as it approaches and rounds the western solar horizon. The series of inbound eastern limb regions are unlikely to present any appreciable risk to the daily probabilities of S1 in the near term.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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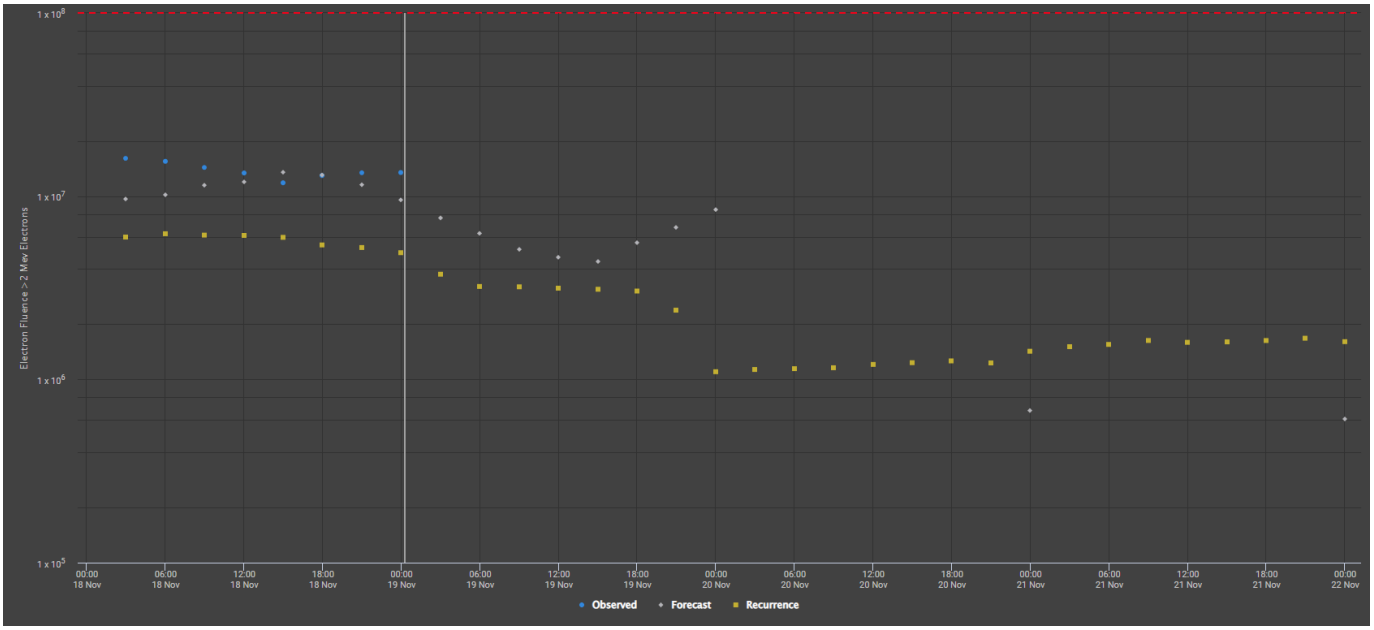
High Energy Electrons (≥ 2MeV)

Current Moderate levels of electron flux at GEO may continue early in the period, before perhaps becoming suppressed if a stronger connection to CH92/+ is established on Day 1 (19 Nov). The initial values unlikely to be of sufficient magnitude to trouble the Active 24-hour integrated threshold - no persistent feature on the disc has resulted in Active fluence. MOSWOC REFM output viewed as providing reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	5	1	1	1
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

Figure 4: MOSWOC REFM electron fluence.



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